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New Developments in 4th generation district heating and smart energy systems

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ABSTRACT

This editorial introduces the 27th volume of the International Journal of Sustainable Energy Planning and Management, which reports some of the latest developments in energy systems analyses of smart energy systems as well as district heating. The issue looks into district heating in Estonia and Norway – as part in a renewable energy transition and flexibility-providing measure. Other analyses look into future prices of renewable energy-based power production systems and optimal design of carbon-neutral energy systems combing EnergyPLAN and EPLANOpt.

Keywords:

District heating;
Energy systems analyses;
EnergyPLAN;
EPLANOpt;

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1. Introduction

This editorial introduces the 27th volume of the International Journal of Sustainable Energy Planning and Management. This volume is a special issue from the *5th International Conference on Smart Energy Systems 4th Generation District Heating, Electrification, Electrofuels and Energy Efficiency*, held in Copenhagen, Denmark in September 2019.

Papers from previous conferences have been published in previous special issues in this journal [1–5] as well as in *Energy* [6–8].

Previously published work has centred on five core topics – transformation and planning [9–12], the operation of grids [13–17], building systems [18], heat and resources [19], and balancing energy systems with a high proportion of renewables [20–22].

2. District heating-based systems

Volkova et al. [23] take a starting point in district heating remaining an important part of the Estonian energy system in the future, however, district heating should evolve towards 4th generation district heating [24,25]. In the analyses, 146 Estonian district heating systems are considered with regard to development potentials in consumption, distribution and generation. With energy savings, improved pipes, and a switch to biomass, carbon-neutral heating may be increased from one third up to 72%. The analyses furthermore link up to the development of a mobile app previously reported in this journal [9].

Askeland et al. [26] investigate the role of district heating in energy systems with a high proportion of hydropower, taking Norway as an example. While Norway by many is foreseen having an important role as a "balancing country" for fluctuating renewable energy integration elsewhere in Europe [27], Norway is also a country with a high present degree of electrification and an ongoing further electrification. One option, which is investigated by Askeland and co-authors is the effect of an introduction of 4th generation district heating on the potential surplus of electricity from Norway. Using EnergyPLAN [28–30], the authors find that there are limited effects and that employing heat storage does not generate much additional flexibility in the energy system.

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3. Energy systems analyses

Prina et al. [31] also employ the energy systems analysis model EnergyPLAN in their analyses; here it is coupled with EPLANOpt [32] to provide a multi-objective evolutionary algorithm-based environment for determining optimal scenario configurations. By applying the setup to the Austrian region Niederösterreich the authors find that *"in order to decarbonize the energy system the increase of the installed power of renewables is not enough to reach the CO_2 reduction objective. Integration methods like the already mentioned storage systems, power to gas, power to heat or power to mobility become relevant."*

Siddiqui et al. [33] investigate electricity-price forecasting in a traditional carbon-based energy system with integration of fluctuating renewable energy sources. While fluctuating renewable energy sources may have low marginal costs, the authors' analyses demonstrate that if fluctuating renewables are to be coupled with storage, then the resulting price will not be competitive against fossil-based alternatives.

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The work presented in this special issue stems from the *5th International Conference on Smart Energy Systems 4th Generation District Heating, Electrification, Electrofuels and Energy Efficiency.* As editors of the journal and/or as organisers of the conference, we acknowledge and appreciate the contributions from the reviewers that have assisted in improving the articles to the standard they have today.

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